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DOTY & ASSOCIATES

GEOTECHNICAL, ENVIRONMENTAL AND GROUND-WATER ENGINEERS

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MEMORANDUM

To: T.C. Greengard
From: B.P. Doty
Date: August 17, 1989

1801-03

Subject: Surface Water Monitoring Program

This memorandum presents a surface water monitoring program for the Rocky Flats Plant. The goal of the program is to monitor for off-site releases via the surface water pathway (including sediments). The memo describes the locations of the monitoring stations and specifies the parameters to be measured at each of the stations. In addition, the monitoring methodology is described.

MONITORING SYSTEMDescription

The surface water monitoring system will consist of three existing stations at the downstream plant boundary (Figure 1). One of the stations (SW-4) will be used to establish non-impacted (background) conditions while the other stations (SW-1 and SW-2) will be used to monitor for potential releases from the plant. Flow rate, water quality, and sediment quality will be monitored at each station. In addition, the timing and quantity of precipitation events will be monitored by the existing plant meteorologic monitoring network.

The intent of the monitoring system is to provide:

1. background flow and water/sediment quality data from areas that have not been affected by plant operations (the Rock Creek Drainage), and
2. flow and water/sediment quality data of run-off and streamflow that may be affected by plant operations at the points of discharge from the plant.

All samples (surface water and sediments) will be analyzed for the parameters shown in Tables 1 through 4.

ADMIN RECORD**SW-A-002958**

The program described in this memorandum will supplement a surface water characterization program being implemented at the plant. The surface water characterization program involves monthly monitoring at 75 stations for a period of six months.

Rationale

The primary intent of this surface water monitoring system is to produce sufficient data to evaluate possible plant releases via the surface water pathway, including sediment transport. The basic concept employed is to monitor at the points of discharge from the plant and to compare the resulting data to similar data from a non-impacted (background) drainage. This section discusses the monitoring station locations with respect to these concepts.

The vast majority of the plant area is drained by either Woman Creek or Walnut Creek (monitored by stations SW-1 and SW-3, respectively). The areas drained by these creeks include essentially all of the areas in which plant related activities have occurred. However, the runoff from an area of approximately 470 acres in the buffer zone between SW-1 and SW-3 will not be monitored by this system (Figure 3). This is considered acceptable because the runoff from essentially all of the plant will be monitored and because no manufacturing or disposal operations have occurred within the un-monitored area.

There is some risk of releases from the plant from the un-monitored area. Fluids from spraying operations or trench disposal on the Rocky Flats terrace to the west could enter the un-monitored area. Additionally, some plutonium has been found in surface soils in this area (apparently resulting from wind dispersal of plutonium from the 903 pad area). Plutonium-bearing soils could be mechanically displaced by runoff events within the un-monitored area and carried across the plant boundary. However, if releases are occurring by these mechanisms, the vast majority of the releases would occur to Woman Creek and should be detectable at SW-1.

Data collected at the points of discharge from the plant will be compared to similar data from a non-impacted (background) drainage, Rock Creek. Data from Rock Creek are believed appropriate for this purpose because no manufacturing operations have occurred in the drainage. In addition, no disposal operations have occurred except for very infrequent destruction of glass vessels containing various inorganic, non-radioactive gases at the site of the Rock Creek Ranch.

Rock Creek is considered the only reliable source of background data because it has similar characteristics to Woman Creek and Walnut Creek. Specifically, Rock Creek drains similar terrain and flows over similar geologic material. Traditional up-gradient monitoring to establish background quality is inappropriate at the plant because of the suspected influence of the different geologic materials on water quality.

How will Rock Creek data be proven to be background?

MONITORING EQUIPMENT

Surface Water Flow and Quality

Flow and quality will be monitored using Parshall flumes coupled with mechanical float based depth recording and run-off event actuated samplers. The timing of the run-off event will be recorded using mechanically operated Stevens recorders.

Flows will be monitored in double throated flumes at all of the stations. Such a flume has already been constructed and is in use for NPDES monitoring at SW-3. The flume has two Parshall flumes in parallel: the first is 6-inches wide at the throat and 42-inches deep; and the second is 36-inches wide and 36-inches deep. Depth of flow will be measured using a spring driven Stevens Type F recorder mounted over a stilling well in hydraulic communication with both flumes. The double throated flumes have a capacity in excess of 30 cfs. Design drawings for the flume at SW-3 can be obtained from plant records.

Water quality samples will be collected with an ISCO composite sampler (or equal). The sampler is battery driven and can be programmed to collect samples at regular intervals or can be activated by the presence of water in the 6-inch flume. The sample will be pumped using the peristaltic pump in the ISCO sampler from a mixing box immediately downstream of the 6-inch flume. The SW-3 installation includes a mixing box. Regular interval sampling (e.g., quarterly) can pump the full sample volume as rapidly as the sampler is capable. Event sampling should collect approximately 250 milliliters of sample every minute, so that a four gallon sample is collected from a one hour run-off event. Eight four-gallon bottles can be connected in a cascade system so that an event lasting eight hours can be completely sampled. It is recommended that the

sampler be installed in an insulated and heated storage building to allow sample collection during freezing weather.

Sediment Chemistry

Two types of sediment samples will be collected. Suspended sediments will be collected with the water samples and quantified by the total analyses (analyses of unfiltered samples). Bedload transported sediments will be collected using a pit sampler (Hubbell, 1964). The pit sampler will consist of a stainless steel tray approximately 3 feet by 3 feet in plan and 12 inches deep. The tray will be placed in a concreted channel section downstream of the Parshall flume (Figure 2) and will collect the bedload transported through the flume.

It is possible that large run-off events will completely fill the tray and that some bedload will not be collected as it moves over the top of the filled tray. However, it is felt that the collected portion will be sufficient to characterize the chemistry of the transported material. Alternatively, small events may not deposit enough material for complete chemical characterization. In this case, only the radioactive constituents will be analyzed.

SAMPLING

Total v. dissolved & preservatives?

DATA QUALITY OBJECTIVES

Data developed in this program will be used by technical specialists and decision-makers on staff with Rockwell International. The data will be used to monitor for on-going releases from the plant property via surface water. Therefore, the crucial data consist of organic chemistry, metals chemistry, major ion chemistry, indicator parameter chemistry and radiochemistry of water and sediments. Analyses must be of sufficient quality and to sufficiently low detection limits that concentrations exceeding those considered to be applicable, relevant and appropriate requirements (ARARs) can be identified. An ARAR analysis for the plant is presented in Rockwell (1989).

Organic analyses will be performed for the compounds on the EPA Contract Laboratory Program (CLP) Target Compound List (TCL) to the CLP required quantitation limit (Table 1). The

CLP quantitation limits are the current practical minimum detection limits and are, therefore, the most sensitive analyses that can be performed. Unfortunately, the currently feasible detection limits for some organic compounds are higher than the ARARs.

Metals analyses will be performed for the compounds on the CLP inorganic Target Analyte List (TAL). In addition, analyses will be performed for:

- Chromium (trivalent),
- Chromium (hexavalent),
- Lithium,
- Strontium, and
- Tin.

These metals have been added to the TAL because they are used at the plant (chromium) or existing ground-water and surface water data indicate possibly anomalous concentrations (lithium, strontium and tin). The list of metals for which analyses will be made and the required detection limits are presented as Table 2. The required detection limits are lower than the ARARs proposed in Rockwell (1989).

Analyses for major ion chemistry and indicator parameters will be performed. Major cations are listed and detection limits specified in Table 2 with the metals. Major anions and the indicator parameters (total dissolved solids and total suspended solids) are listed and detection limits specified in Table 3. The required detection limits are lower than the ARARs proposed in Rockwell (1989).

Analyses will for radiochemistry will also be performed (Table 4). The results will be compared to EPA and CDH ARARs and to historical background determinations made by Rockwell. In some cases, background concentrations are lower than the regulatory ARARs. Therefore, the required minimum detectable activities are lower than the ARARs proposed in Rockwell (1989) and lower than historical background determinations.

DATA EVALUATION

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DRAFT

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REFERENCES

Hubbell, D.W., 1964, Apparatus and Techniques for Measuring Bedload, U.S. Geological Survey Water-Supply Paper 1748.

Rockwell, 1989, Quality Assurance/Quality Control Plan, Environmental Restoration Program, Rocky Flats Plant, Revision 1, Rockwell International, Aerospace Operations, Golden, Colorado, January.

Table 1. Target Compound List Organics

Volatiles	CAS Number	-----Quantitation Limits**-----	
		Water ug/L	Low Soil/Sediment ^a ug/Kg
1. Chloromethane	74-87-3	10	10
2. Bromomethane	74-83-9	10	10
3. Vinyl Chloride	75-01-4	10	10
4. Chloroethane	75-00-3	10	10
5. Methylene Chloride	75-09-2	5	5
6. Acetone	67-64-1	10	10
7. Carbon Disulfide	75-15-0	5	5
8. 1,1-Dichloroethene	75-35-4	5	5
9. 1,1-Dichloroethane	75-34-3	5	5
10. 1,2-Dichloroethene (total)	540-59-0	5	5
11. Chloroform	67-66-3	5	5
12. 1,2-Dichloroethane	107-06-2	5	5
13. 2-Butanone	78-93-3	10	10
14. 1,1,1-Trichloroethane	71-55-6	5	5
15. Carbon Tetrachloride	56-23-5	5	5
16. Vinyl Acetate	108-05-4	10	10
17. Bromodichloromethane	75-27-4	5	5
18. 1,1,2,2-Tetrachloroethane	79-34-5	5	5
19. 1,2-Dichloropropane	78-87-5	5	5
20. trans-1,3-Dichloropropene	10061-02-6	5	5
21. Trichloroethene	79-01-6	5	5
22. Dibromochloromethane	124-48-1	5	5
23. 1,1,2-Trichloroethane	79-00-5	5	5
24. Benzene	71-43-2	5	5
25. cis-1,3-Dichloropropene	10061-01-5	5	5
26. Bromoform	75-25-2	5	5
27. 2-Hexanone	591-78-6	10	10
28. 4-Methyl-2-pentanone	108-10-1	10	10
29. Tetrachloroethene	127-18-4	5	5
30. Toluene	108-88-3	5	5
31. Chlorobenzene	108-90-7	5	5
32. Ethyl Benzene	100-41-4	5	5
33. Styrene	100-42-5	5	5
34. Total Xylenes	1330-20-7	5	5

Table 1. Target Compound List Organics (continued)

Semi-Volatiles	CAS Number	-----Quantitation Limits**-----	
		Water ug/L	Low Soil/Sediment ^p ug/Kg
35. Phenol	108-95-2	10	330
36. bis(2-Chloroethyl) ether	111-44-4	10	330
37. 2-Chlorophenol	95-57-8	10	330
38. 1,3-Dichlorobenzene	541-73-1	10	330
39. 1,4-Dichlorobenzene	106-46-7	10	330
40. Benzyl Alcohol	100-51-6	10	330
41. 1,2-Dichlorobenzene	95-50-1	10	330
42. 2-Methylphenol	95-48-7	10	330
43. bis(2-Chloroisopropyl) ether	108-60-1	10	330
44. 4-Methylphenol	106-44-5	10	330
45. N-Nitroso-di-n- Dipropylamine	621-64-7	10	330
46. Hexachloroethane	67-72-1	10	330
47. Nitrobenzene	98-95-3	10	330
48. Isophorone	78-59-1	10	330
49. 2-Nitrophenol	88-75-5	10	330
50. 2,4-Dimethylphenol	105-67-9	10	330
51. Benzoic Acid	65-85-0	50	1600
52. bis(2-Chloroethoxy) methane	111-91-1	10	330
53. 2,4-Dichlorophenol	120-83-2	10	330
54. 1,2,4-Trichlorobenzene	120-82-1	10	330
55. Naphthalene	91-20-1	10	330
56. 4-Chloroaniline	106-47-8	10	330
57. Hexachlorobutadiene	87-68-3	10	330
58. 4-Chloro-3-methylphenol (para-chloro-meta-cresol)	59-50-7	10	330
59. 2-Methylnaphthalene	91-57-6	10	330
60. Hexachlorocyclopentadiene	77-47-4	10	330
61. 2,4,6-Trichlorophenol	88-06-2	10	330
62. 2,4,5-Trichlorophenol	95-95-4	50	1600
63. 2-Chloronaphthalene	91-58-7	10	330
64. 2-Nitroaniline	88-74-4	50	1600
65. Dimethylphthalate	131-11-3	10	330

Table 1. Target Compound List Organics (continued)

Semi-Volatiles	CAS Number	-----Quantitation Limits**-----	
		Water ug/L	Low Soil/Sediment ^b ug/Kg
66. Acenaphthylene	208-96-8	10	330
67. 3-Nitroaniline	99-09-2	50	1600
68. Acenaphthene	83-32-9	10	330
69. 2,4-Dinitrophenol	51-28-5	50	1600
70. 4-Nitrophenol	100-02-7	50	1600
71. Dibenzofuran	132-64-9	10	330
72. 2,4-Dinitrotoluene	121-14-2	10	330
73. 2,6-Dinitrotoluene	606-20-2	10	330
74. Diethylphthalate	84-66-2	10	330
75. 4-Chlorophenyl Phenyl ether	7005-72-3	10	330
76. Fluorene	86-73-7	10	330
77. 4-Nitroaniline	100-01-6	50	1600
78. 4,6-Dinitro-2-methyl- phenol	534-52-1	50	1600
79. N-nitrosodiphenylamine	86-30-6	10	330
80. 4-Bromophenyl Phenyl ether	101-55-3	10	330
81. Hexachlorobenzene	118-74-1	10	330
82. Pentachloropphenol	87-86-5	50	1600
83. Phenanthrene	85-01-8	10	330
84. Anthracene	120-12-7	10	330
85. Di-n-butylphthalate	84-74-2	10	330
86. Fluoranthene	206-44-0	10	330
87. Pyrene	129-00-0	10	330
88. Butylbenzylphthalate	85-68-7	10	330
89. 3,3'-Dichlorobenzidine	91-94-1	20	660
90. Benzo(a)anthracene	56-55-3	10	330
91. bis(2-ethylhexyl) phthalate	117-81-7	10	330
92. Chrysene	218-01-9	10	330
93. Di-n-octyl Phthalate	117-84-0	10	330
94. Benzo(b)fluoranthene	205-99-2	10	330
95. Benzo(k)fluoranthene	207-08-9	10	330
96. Benzo(a)pyrene	50-32-8	10	330
97. Indeno(1,2,3-cd)pyrene	193-39-5	10	330
98. Dibenz(a,h)anthracene	53-70-3	10	330
99. Benzo(g,h,i)perylene	191-24-2	10	330

Table 1. Target Compound List Organics (continued)

Pesticides/PCBs	CAS Number	-----Quantitation Limits**-----	
		Water ug/L	Low Soil/Sediment ^c ug/Kg
100. alpha-BHC	319-84-6	0.05	8.0
101. beta-BHC	319-85-7	0.05	8.0
102. delta-BHC	319-86-8	0.05	8.0
103. gamma-BHC (Lindane)	58-89-9	0.05	8.0
104. Heptachlor	76-44-8	0.05	8.0
105. Aldrin	309-00-2	0.05	8.0
106. Heptachlor Epoxide	1024-57-3	0.05	8.0
107. Endosulfan I	959-98-8	0.05	8.0
108. Dieldrin	60-57-1	0.10	16.0
109. 4,4'-DDE	72-55-9	0.10	16.0
110. Endrin	72-20-8	0.10	16.0
111. Endosulfan II	33213-65-9	0.10	16.0
112. 4,4'-DDD	72-54-8	0.10	16.0
113. Endosulfan Sulfate	1031-07-8	0.10	16.0
114. 4,4'-DDT	50-29-3	0.10	16.0
115. Endrin Ketone	53494-70-5	0.10	16.0
116. Methoxychlor	72-43-5	0.5	80.0
117. alpha-Chlordane	5103-71-9	0.5	80.0
118. gamma-Chlordane	5103-74-2	0.5	80.0
119. Toxaphene	8001-35-2	1.0	160.0
120. AROCLOR-1016	12674-11-2	0.5	80.0
121. AROCLOR-1221	11104-28-2	0.5	80.0
122. AROCLOR-1232	11141-16-5	0.5	80.0
123. AROCLOR-1242	53469-21-9	0.5	80.0
124. AROCLOR-1248	12672-29-6	0.5	80.0
125. AROCLOR-1254	11097-69-1	1.0	160.0
126. AROCLOR-1260	11096-82-5	1.0	160.0

^aMedium Soil/Sediment Required Quantitation Limits (RQL) for Volatile
TCL Compounds are 125 times the individual Low Soil/Sediment RQL.

^bMedium Soil/Sediment Required Quantitation Limits (RQL) for Semi-
Volatile TCL Compounds are 60 times the individual Low Soil/Sediment RQL.

^cMedium Soil/Sediment Required Quantitation Limits (RQL) for Pesticide
TCL compounds are 15 times the individual Low Soil/Sediment RQL.

*These are the EPA quantitation limits under the Contract Laboratory Program. Specific quantitation
limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance
and may not always be achievable.

**Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits
calculated by the laboratory for soil/sediment, calculated on dry weight basis, as required by the
contract, will be higher.

Table 2. Target Analyte List plus Additional Metals

Element	Nominal Detection Limit ^{1,2}	
	Water (ug/l)	Soil (mg/kg)
Aluminum	200	40
Antimony	60	12
Arsenic	10	2
Barium	200	40
Beryllium	5	1.0
Cadmium -	5	1.0
Calcium	5000	2000
Chromium	10	2.0
Cobalt	50	10
Copper	25	5.0
Iron	100	20
Lead	5	1.0
Magnesium	5000	2000
Manganese	15	3.0
Mercury	0.2	0.2
Nickel	40	8.0
Potassium	5000	2000
Selenium	5	1.0
Silver	10	2.0
Sodium	5000	2000
Thallium	10	2.0
Vanadium	50	10.0
Zinc	20	4.0
Cyanide	10	10
Cesium ³	1000	200
Chromium (VI) ³	10	1
Lithium ³	100	20
Molybdenum ³	200	40
Strontium ³	200	40
Tin ³	200	40

Table 2. Target Analyte List plus Additional Metals
(continued)

¹Higher detection levels may also be used in the following circumstances.

- If the sample concentration exceeds two times the detection limit of the instrument or method in use, the value may be reported even though the instrument or method detection limit may not equal the nominal detection limit. This is illustrated in the example below:

For lead: -

Method in use - ICP
Instrument Detection Limit (IDL) = 40
Sample Concentration = 85
Contract Required Detection Limit (CRDL) = 5

The value of 85 may be reported even though instrument detection limit is greater than nominal detection level. The instrument or method detection limit must be documented.

²The given detection limits are the instrument detection limits obtained in pure water using the procedures given in Tables 3-3 and 3-4. The detection limits for samples may be considerably higher depending on the sample matrix.

³These are non-CLP Target Analytes.

Table 3. Major Anions and Indicator Parameters

<u>Compound</u>	DETECTION LIMITS	
	<u>Water</u> <u>(mg/l)</u>	<u>Sediment</u> <u>(ug/g)</u>
Bicarbonate	10	-
Carbonate	10	-
Chloride	5	60
Nitrate as N	5	60
Sulfate	5	60
Total Dissolved Solids	5	-
Total Suspended Solids	10	-

Notes:

- indicates analyses will not be run.

Table 4. Radiochemistry Parameters

<u>Compound</u>	<u>MINIMUM DETECTABLE ACTIVITIES</u>	
	<u>Water</u>	<u>Sediment</u>
Gross Alpha	2	4
Gross Beta	2	10
Tritium	400	-
Plutonium 239 + 240	0.01	0.03
Americium 241	0.01	0.02
Uranium 233 + 234	0.6	0.3
Uranium 235	0.6	0.3
Uranium 238	0.6	0.3
Strontium 90	1	1
Cesium 137	1	0.1
Radium 226	0.5	0.5
Radium 228	1	0.5

Notes:

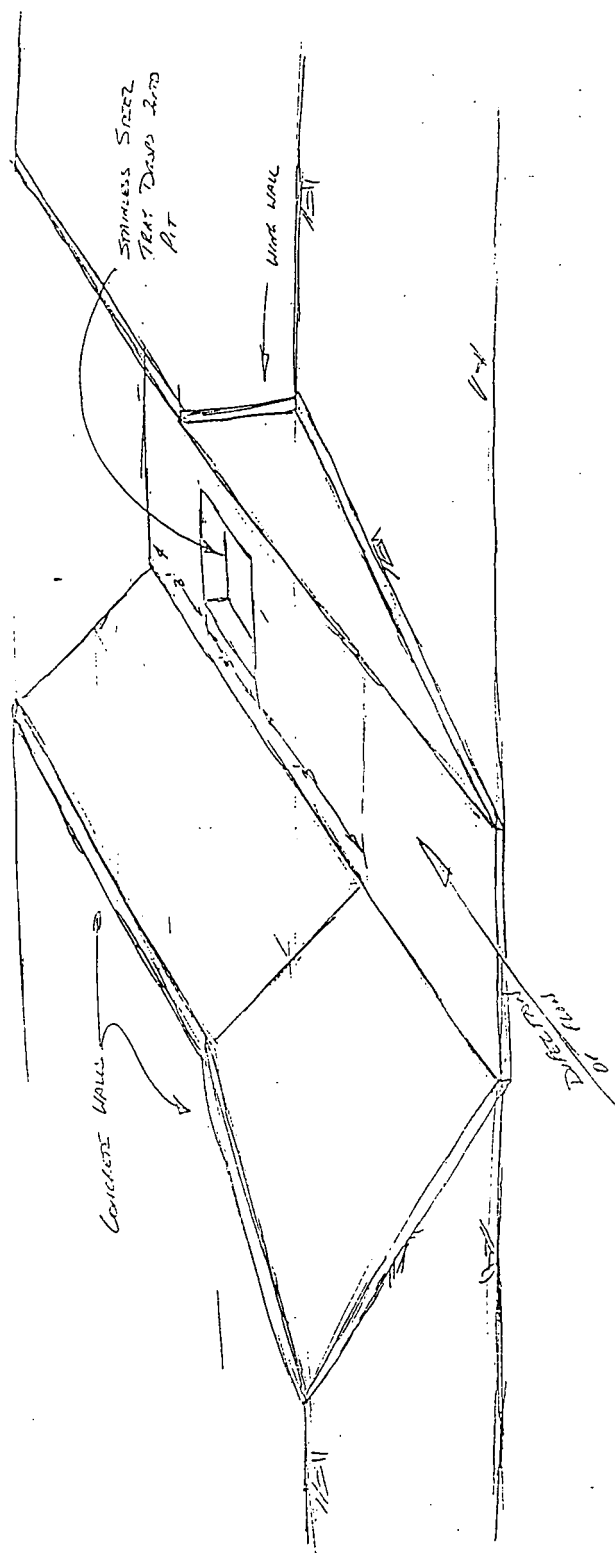
Units of measure are picoCuries per liter (pCi/l) for water and picoCuries per gram (pCi/g) for sediment.

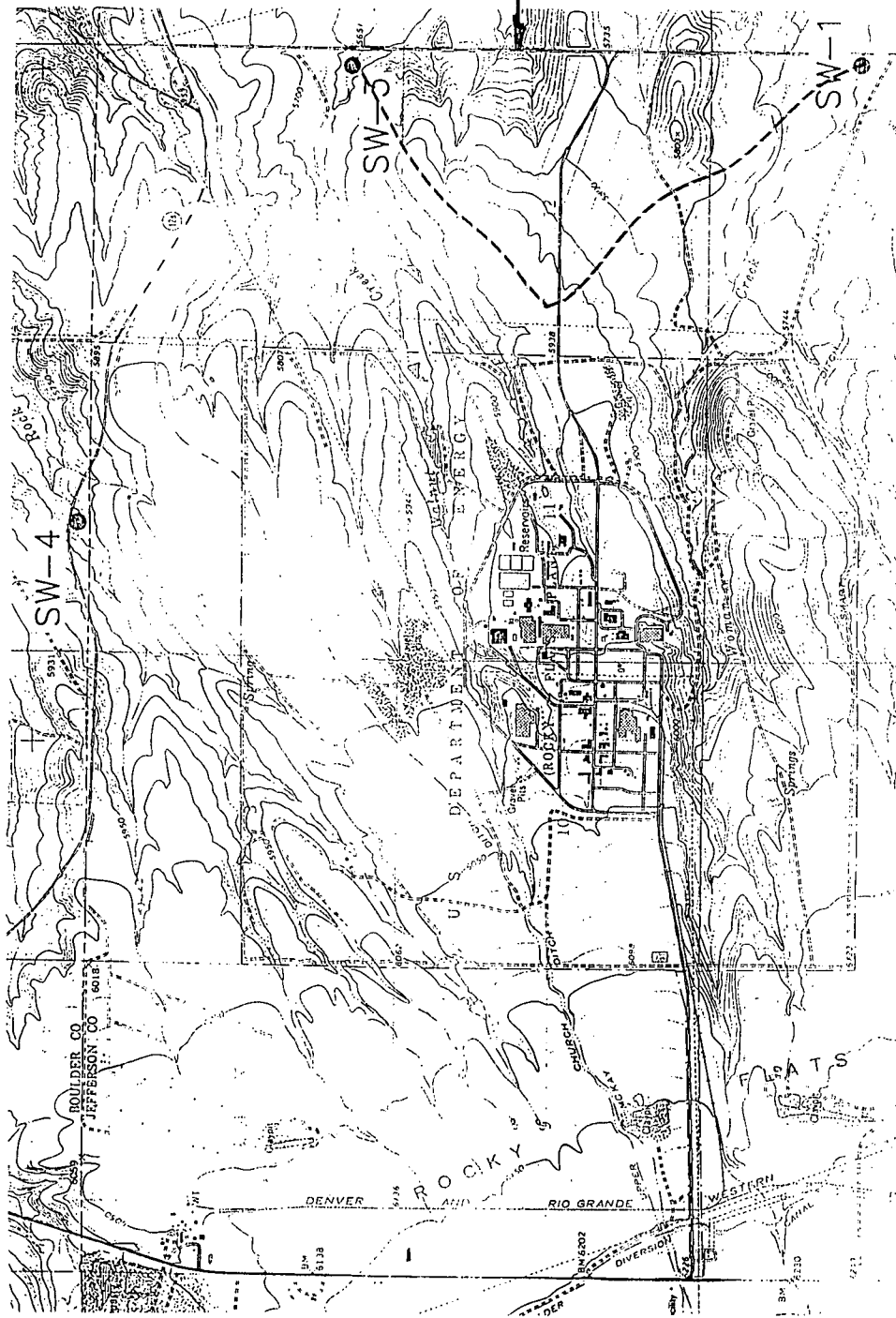
Radium analyses performed only if gross alpha is greater than 5 pCi/l. First, radium 226 is analyzed. If radium 226 is greater than 3 pCi/l, then radium 228 is analyzed.

- indicates analysis will not be run.

FIGURE 2.

PIT SAMPLER INSTALLATION





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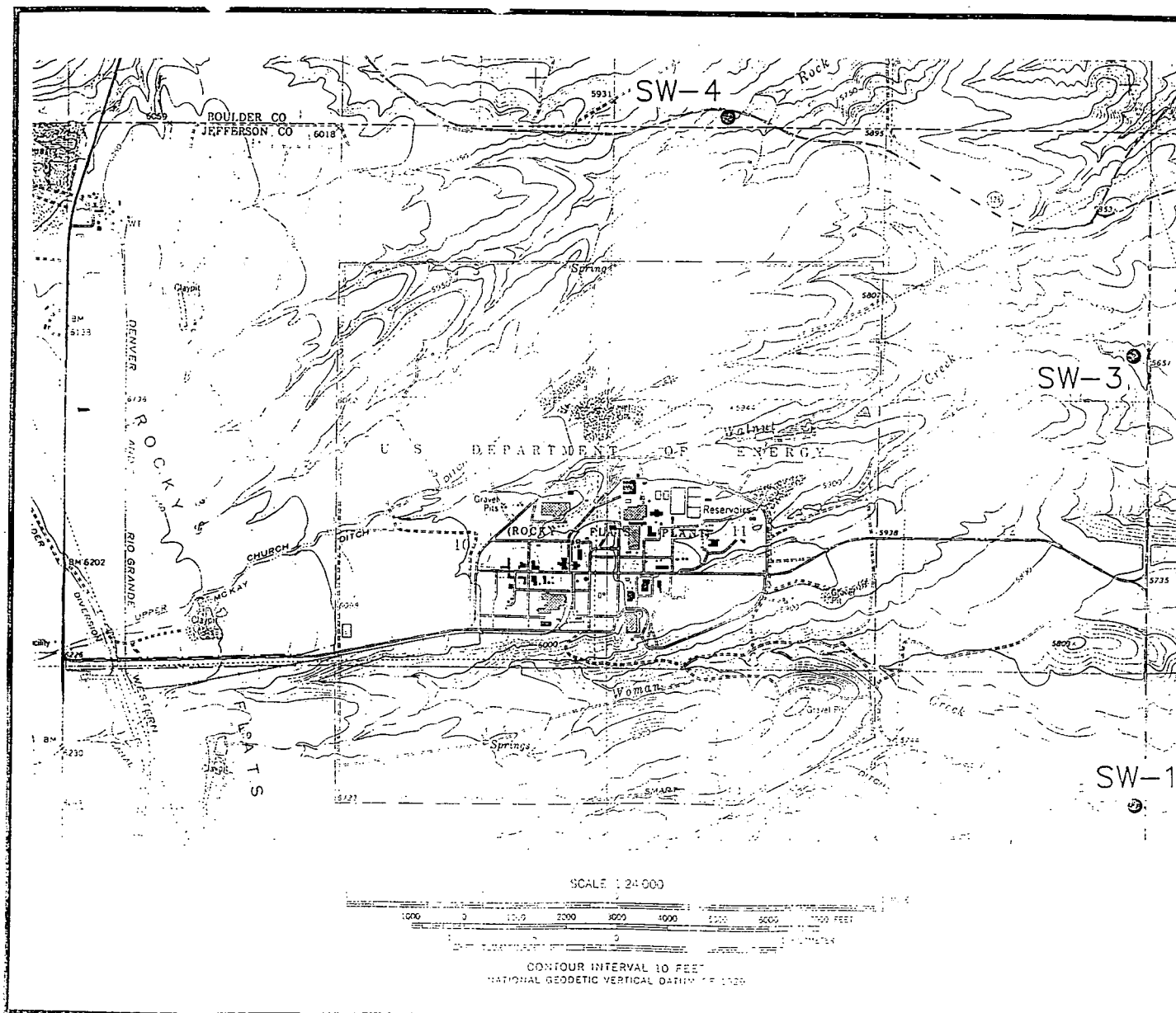
FIGURE 3.

UN-MONITORED AREA

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FIGURE 1.

MONITORING SYSTEM LAYOUT

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